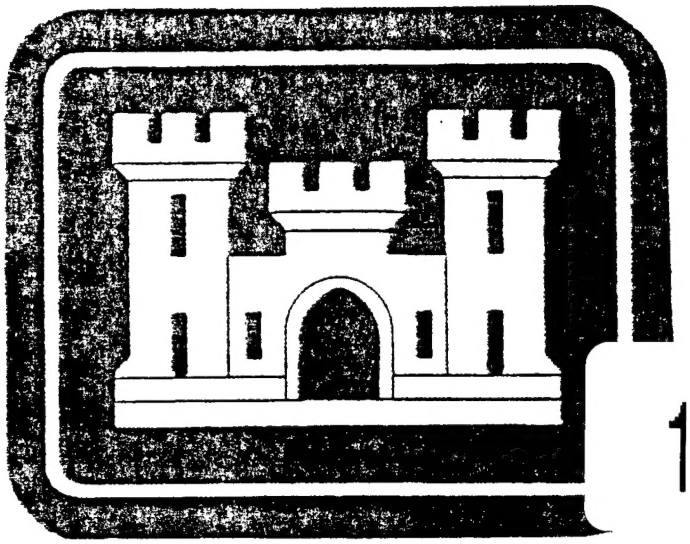
LIMITED ENERGY STUDIES
FORT RUCKER, ALABAMA



U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT

CONTRACT NUMBER DACA01-92-C-0119

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PREPARED FOR:
MOBILE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MOBILE, ALABAMA

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1.0 INTRODUCTION AND PROJECT OVERVIEW

In August of 1992, Engineering Resource Group, Inc., was retained by the Mobile District U.S. Army Corps of Engineers to perform Limited Energy Studies at Fort Rucker, Alabama. These studies were to address specific projects at Fort Rucker and at the Lyster Army Community Hospital on base that had potential to reduce energy costs through energy demand control or energy conservation. This report summarizes results from the investigations made by Engineering Resource Group and their consultant into the specific projects defined by the Contract Scope Of Work.

1.1 Scope Of Work

There are two main areas of work addressed under this contract, an LP gas storage study for Fort Rucker and the evaluation of two energy conservation opportunities for Lyster Army Community Hospital.

1.1.1 LP Gas Storage:

The objective of this project was to evaluate the technical and economic feasibility of building and operating a liquified petroleum gas (LPG) storage facility at Fort Rucker. The primary heating fuel at Fort Rucker is natural gas; it is used in central steam plants and in central forced-air furnaces for family housing. Natural gas is purchased from the Southeast Alabama Gas District at their lowest rate. However, Fort Rucker also pays a natural gas demand charge based on the amount of natural gas used during curtailment. During a curtailment period, the natural gas demand is intended to be reduced as much as possible by switching the central steam plants to oil; but the family housing area continues to use natural gas. An LPG storage system would provide the capability of injecting a mixture of air and propane into the natural gas distribution system during curtailment to reduce natural gas demand. This would result in lower gas bills throughout the year.

1.1.2 Lyster Army Community Hospital

An Energy Engineering Analysis Program study was completed for Lyster Army Community Hospital in 1989. The following two projects address one additional project not included in the original EEAP study and a reevaluation of one that had been included. Further analysis is to determine the interrelationship of these two projects.

1.1.2.1 Cooling Storage System For Peak Demand Reduction

The objective of this project was to evaluate the technical and economic feasibility of reducing peak electrical demand at the hospital by use of a cooling storage system. This study will determine the optimum type of cooling storage system for the hospital. Accurate evaluation of this project required the modeling of building thermal loads with an approved computer simulation program such as Trane TRACE.

1.1.2.2 Chiller Heat Recovery For Domestic Hot Water

The objective of this project was to evaluate the technical and economic feasibility of recovering heat from the hospital chillers for preheating domestic hot water with and without the cooling storage system mentioned above. Heat recovery from chillers was recommended in the 1989 study but has not been implemented.

1.2 Description Of Work

In order to completely address all of the considerations required to properly evaluate the projects defined in the Scope Of Work, the following procedures were to be followed in accordance with the contract.

1. Review the previously completed energy studies which apply to the buildings, systems, or energy conservation opportunities (ECOs) covered by this study.

2. Perform a limited site survey of specific buildings or areas to collect all data required to evaluate the specific ECOs included in this study.

3. Reevaluate the specific project or ECO from the previous study to determine its economic feasibility based on revised criteria, current site conditions and technical applicability.

4. Evaluate specific ECOs to determine their energy savings potential and economic feasibility.

5. Provide project documentation for recommended ECOs as detailed herein.

6. Prepare a comprehensive report to document all work performed, the results and all recommendations.

1.3 Criteria And Methodology

Criteria utilized to reach the conclusions established in this study are as follows. Where appropriate, this information in whole or part is included as part of the appendices.

1. "Engineering and Design Energy Conservation", Department of the Army, Office of the Chief of Engineers, Washington, D. C., 20314, ETL 1110-3-282, dated 10 February 1978.

2. "Energy Conservation Investment Program (ECIP) Guidance", memorandum CEHSC-FU-M dated 23 November 1991 and revisions dated 28 June 1991 and 4 November 1992.

3. "Military Construction, Army (MCA) Program Development", Headquarters Department of the Army, Washington , D. C., Army Regulation 415-15, effective 1 January 1984.

4. "Facilities Engineering Energy Storage Systems, Lessons From Field Demonstration And Testing Of Storage Cooling Systems", Department of the Army, U. S. Army Engineering and Housing Support Center, Fort Belvoir, VA, 22060-5516, Technical Note No. 5-670-1, dated 16 April 1992.

5. The Southeast Alabama Gas District Billing History, Fort Rucker.

6. Alabama Power Company Revision No. 8 - Rate Schedule MR-1.

7. Alabama Power Company Customer Data Sheet, Year 1992, U. S. Army Aviation Center, Ft. Rucker.

8. Alabama Power Company KW/KVA/KVAR Power Factor Summary, U. S. Army Aviation Center.

9. 1989 Energy Survey, Lyster Army Community Hospital, Fort Rucker, Alabama, U. S. Army Corps of Engineers Mobile District, Contract Number DACA01-87-C-0084, Energy Management Consultants, Inc., Birmingham, Alabama.

10. ASHRAE Handbooks: "1987 HVAC Handbook, Systems and Applications", American Society of Heating Refrigerating and Air Conditioning Engineers, Inc.

11. "Means Mechanical Cost Data", 1993 Edition.

12. "Investigation Report And Draft Acquisition Plan", Exeter Associates, Inc., Contract Number DACA72-88-D-0005, dated June 1989.

13. "Seminar Notes: Thermal Energy Storage Systems", Mackie Associates, November 1992.

14. "Case Studies Of Chilled Water Storage", John S. Andrepont, Product Manager, Thermal Systems, Chicago Bridge & Iron Co., 1993.

15. "Case Study Of A Large, Naturally Stratified, Chilled-Water Thermal Energy Storage System", Donald P. Fiorino, P.E., Member ASHRAE, IN-91-20-2.

16. "Thermal Energy Storage Program For The 1990s", Donald P. Fiorino, P.E., Texas Instruments, Inc., Vol. 89, No. 4, 1992.

17. "How To Put A Chill On Rising Energy Costs", NATGUN, 1991.

18. "Stratified Chilled-Water Storage Design Guide", Electric Power Research Institute (EPRI), May 1988.

Methodology to evaluate the LP Gas Storage system included a comprehensive review of gas bills from Southeast Alabama Gas District, applicable gas rates and the report prepared by Exeter Associates, Inc., listed above in the criteria utilized list.

Methodology to determine cooling load profiles at Lyster Army Community Hospital included the utilization of Trane TRACE to model the facility. Input data from the original 1989 EEAP Study was retrieved, verified, and a new input model was developed for the specific purpose of evaluating cooling storage. This data was then used to perform manual simulations to determine the impact of cooling storage at the hospital on the base electrical meter.

1.4 Organization

An entry interview was held at Lyster Army Community Hospital on September 9, 1992, to review the project objectives and discuss each participants role and procedures for execution. All parties listed below with the exception of Ms. Winnett were present. Field visits were made by Mr. Jackins and Mr. Guthrie during October, November and December 1992. Evaluations and analysis of the selected projects were done during January and February 1993. The report has been written in March 1993 for the Interim Submittal to be made by 31 March 1993. The project is to be completed by 15 May 1993.

The principal participants in the preparation of this study are:

For The Owner: U. S. Army
Mr. Tony Battaglia
Mobile District U. S. Army Corps Of Engineers

Mr. Bill DeJournett, Energy Manager, DEH
Fort Rucker, Alabama

Mr. Alan Plant, Facility Manager, EMCS
Lyster Army Community Hospital
Fort Rucker, Alabama

For The Contractor: Engineering Resource Group, Inc.
Mr. George A. Jackins, P.E.
Project Manager

Mr. Boyce Guthrie, P.E.
L.P. Gas Peak Shaving Consultant

Ms. Kelly L. Winnett
Project Engineer

2.0 EXECUTIVE SUMMARY

In August of 1992, Engineering Resource Group, Inc., of Birmingham, Alabama was retained by the Mobile District U. S. Army Corps of Engineers to perform Limited Energy Studies at Fort Rucker, Alabama. These studies were limited to the evaluation of specific projects that have potential to reduce energy costs through energy demand control or conservation. These projects are:

1. LP Gas Storage: Evaluate the technical and economic feasibility of building and operating a liquified petroleum gas (LPG) storage facility at Fort Rucker to reduce natural gas demand charges.

2. Cooling Storage System For Peak Demand Reduction: Evaluate the technical and economic feasibility of reducing peak electrical demand at Lyster Army Community Hospital by the use of a cooling storage system.

3. Chiller Heat Recovery For Domestic Hot Water: Evaluate the technical and economic feasibility of recovering heat from the hospital chillers for preheating domestic hot water at Lyster Army Community Hospital.

Each project is summarized individually in the following discussions.

LP Gas Storage

During the twelve month period from September 1991 to August 1992, Fort Rucker paid the Southeast Alabama Gas District a total of $2,019,981.50 for the delivery of natural gas to the base. This natural gas was used to fire boilers in five central steam plants and to heat family housing. Of this total cost, $491,647.22 or 24% was demand charges. The demand charges each month is established by the highest daily usage during a period of curtailment. On January 16, 1992, when the base was on curtailment, the daily usage was recorded at 3,436 MCF which set the basis for demand charges for the following eleven months. If this one day demand could have been reduced, it would have resulted in a lower delivered natural gas cost for the rest of the year.

One method of reducing this peak daily usage during a period of curtailment is to switch the dual fuel boilers in the central steam plants from natural gas to oil. The investigations conducted in this study indicated, however, that this was not done during the January 1992 period of curtailment. Assuming that there was good reason for not switching to oil during that period, this study examines the use of an appropriately sized LP Gas Peak Shaving plant as the only means of reducing demand during curtailment and evaluates the added benefit of switching from natural gas to oil in the central steam plants.

The economics of utilizing various sizes of LP Gas Peak Shaving plants are examined in this study. Considering good practice in the design and operation of such plants coupled with the added benefits of fuel switching in the central steam plants, a capacity of 1,500 MCF per day was selected for the proposed LP Gas Peak Shaving plant.

Annual Savings, MCF Demand	-	1,500
Annual Cost Savings	-	$200,794
Total Investment	-	$970,050
Simple Payback	-	4.83 Years
Total Net Discounted Savings	-	$4,136,356
Savings To Investment Ratio (SIR)	-	4.26
Adjusted Internal Rate Of Return (AIRR)	-	12.00%

Cooling Storage System For Peak Demand Reduction

Lyster Army Community Hospital, Building 301 located at Fort Rucker, Alabama is a 72 bed total health care facility with a gross area of 206,720 square feet. It is presently cooled by a chilled water plant in the building utilizing three centrifugal chillers with a total capacity of 820 tons. These chillers are currently manually staged by operating personnel to meet building cooling loads.

A comprehensive Energy Engineering Analysis Program (EEAP) was performed at Lyster Army Community Hospital in 1989. The results of this program were available to facilitate the appropriate direction of the Limited Energy Studies evaluated under this contract. One of the Energy Conservation Opportunities (ECO 2) defined in the 1989 study has a significant impact on the ease of implementation of a Cooling Storage System. This ECO provides for the installation of primary-secondary chilled water loops with variable speed pumping in the secondary loop. Base personnel advised that this ECO has been selected for implementation and engineering has been done. The project implementation is now predicated on funding. This project to study a Cooling Storage System for Peak Demand Reduction has been developed assuming that ECO 2 from the 1989 study will be implemented.

An analysis of the 24 hour electrical load profile of the hospital during a peak summer day indicates a relatively level load. This, plus the fact that there are no specific incentives in the electric rate applicable to the base such as off peak demand cost reduction, would indicate that little potential existed for load shifting for demand reduction.

However, an examination of the same profile for the entire base reveals a significant swing from on peak loads to off peak loads. This swing on a peak summer day is as much as 15,000 KVA, more than enough to absorb the off peak use of the remaining unused capacity of the hospital chillers for storage. Utilizing Trane TRACE 24 hour cooling load profiles of the hospital, a strategy was developed to store adequate chilled water during off peak hours to meet the total cooling requirements of the hospital during the on peak six hour period the next day. This strategy results in a reduction of monthly demands at the base electric meter for 8 of the 12 months due to the 75% demand ratchet applicable to the peak summer month.

Annual Savings, KVA Demand	-	3,093.6
Annual Cost Savings	-	$47,964
Total Investment	-	$338,824
Simple Payback	-	7.06 Years
Total Net Discounted Savings	-	$651,831
Savings To Investment Ratio (SIR)	-	1.92
Adjusted Internal Rate Of Return (AIRR)	-	7.45%

Chiller Heat Recovery For Domestic Hot Water

The Energy Engineering Analysis Program (EEAP) performed at Lyster Army Community Hospital in 1989 identified and recommended and ECO to utilize waste heat from one centrifugal chiller to preheat domestic hot water. This ECO is reevaluated in this study based on current implementation and energy costs. Additionally, an analysis has been performed of the impact of the selected chilled water storage strategy on this ECO.

Based on a review of the original estimate to implement the chiller heat recovery ECO, it was found that this estimated cost increased from $21,870 to $27,820. At the same time energy costs reduced from those used in the original ECO as follows:

Electrical Energy: From $0.043993/KWH To $0.0215/KWH

Natural Gas: From $0.411/Therm To $0.289/Therm

It was established that the methodology and estimates made of energy savings in the original ECO were reasonable and would be used in this reevaluation. The economics of the project change significantly as follows.

Annual Energy Savings:		
Electric	-	139.56 MBTU/Year
Natural Gas	-	963.60 MBTU/Year
Total	-	1,103.16 MBTU/Year
Annual Cost Savings:		
Electric	-	$879
Natural Gas	-	$2,785
Total	-	$3,664
Total Investment	-	$31,019
Simple Payback	-	8.47
Total Net Discounted Savings	-	$70,248
Savings To Investment Ratio (SIR)	-	2.26
Adjusted Internal Rate Of Return (AIRR)	-	8.00%

The revised economics for this ECO make its desirability for implementation questionable. It must be combined with other projects to be considered as an ECIP project.

As part of this ECO, further analysis was performed to determine the impact of the proposed cooling storage strategy on the heat recovery capability of the centrifugal chiller. Based on Trane TRACE projections of ton-hours produced by the chiller before and after, there was a projected reduction of chiller operating time of 36%. This reduction impacted the estimated energy savings and costs by the same amount. The resulting payback of the heat recovery ECO if combined with the cooling storage ECO is 11.85 years making this ECO not recommended if the cooling storage ECO is implemented.